What is claimed is:

Sub C1

1. A method of making a carbon fiber/silicon composite body, comprising:

(a) providing a reinforcement material comprising a plurality of carbon fibers;

(b) organizing said reinforcement material to a desired bulk shape

(c) applying one or more coatings to said fibers, said coatings intended to protect said fibers from chemical reaction with molten silicon, and intended to permit no more than a weak mechanical bond to the matrix;

(d) supplying no more than about 10 percent by weight carbon to the arranged fibers to make a preform;

(e) contacting a source of molten silicon metal to said preform;

(f) infiltrating silicon from said source into said preform, thereby forming a composite material comprising said carbon fibers dispersed in a matrix comprising said silicon metal; and

(g) solidifying said silicon metal in said composite material, thereby forming a composite body.

2. A method for making a carbon fiber/silicon/silicon carbide composite body, comprising:

(a) providing a porous zero-stage carbon/carbon composite preform comprising carbon fibers dispersed in a matrix consisting predominantly of carbon;

(b) contacting said composite preform to a source of molten infiltrant comprising silicon metal;

(f) infiltrating silicon from said source into said preform, thereby forming a composite material comprising said carbon fibers dispersed in a matrix comprising said silicon metal; and

(g) solidifying said silicon metal in said composite material, thereby forming a composite body.

3. A method for making a carbon fiber/silicon composite body, comprising:

(a) providing a reinforcement material comprising a plurality of carbon fibers;

(b) contacting a silicon-containing polymeric resin to at least said carbon fibers;

(c) pyrolyzing the preceramic polymer to leave a silicon-containing ceramic coating on the carbon fibers, such as SiC, thereby forming a preform;

(d) supplying the preform with a source of reactable carbon;

(e) pyrolyzing the reactable carbon source, leaving the preform with about 1 to about 10 percent by volume of reactable carbon; and

(f) reactively infiltrating the preform with the silicon or silicon alloy to yield a composite body comprising carbon fibers having a SiC coating, and a matrix comprising Si (or alloy) and at least some in-situ SiC; and

(g) solidifying said silicon metal in said composite material, thereby forming a composite body.

4. A carbon fiber/silicon/silicon carbide composite body, comprising:

(a) a plurality of carbon fibers;

(b) a matrix phase comprising at least about 15 percent by volume of silicon and not more than about 40 volume percent silicon carbide; and

(c) a zone of carbon disposed between said fibers and said matrix.

5. A carbon fiber/silicon composite body, comprising:

(a) a matrix phase comprising at least about 30 percent by volume of silicon and not more than about 10 volume percent silicon carbide;

(b) a reinforcement phase comprising a plurality of carbon fibers; and

(c) one or more coatings disposed between said fibers and said matrix, said coatings serving functions comprising chemical protection of said carbon fibers at least from said silicon and providing a toughening mechanism for said composite.

6 ~~5a~~. The composite body of claim 5, wherein said matrix phase comprises at least one metal other than silicon.

7 ~~6~~. The composite body of claim 5a, wherein said at least one metal comprises aluminum.

8 ~~7~~. The composite body of claim 5, wherein said protective coating comprises silicon carbide.

9 ~~8~~. The composite body of claim 5, wherein said debond coating comprises boron nitride.

10 ~~9~~. The composite body of claim 5, wherein said carbon fibers make up about 10 % to about 70% by volume of said composite body.

11 ~~10~~. The composite body of claim 5, comprising at least about 45% of said silicon phase.

12 ~~11~~. The composite body of claim 5, wherein said SiC of said matrix phase comprises less than about 10% of said composite body.

13 ~~11a~~. The composite body of claim 5, wherein said SiC of said matrix phase comprises about 1%-5% of said composite body.

14 ~~12~~. The composite body of claim 5, wherein said carbon fibers are provided as a series of stacked plies, with fibers within a ply arranged substantially parallel to one another.

15 ~~13~~. The composite body of claim 5, wherein said carbon fibers are provided as a series of stacked plies, with fibers within a ply being woven.

14. The composite body of claim 13, wherein said woven arrangement comprises a weave selected from a plain weave and a harness satin weave.

15. The composite body of claim 5, further comprising a CTE less than about +2 ppm/K.

16. The composite body of claim 5, further possessing an absolute value of CTE less than about 1 ppm/K.

17. The method of claim 2, wherein said carbon of said matrix derives from at least one source selected from the group consisting of pitch, phenolic resin, furfuryl alcohol and epoxy resin.

19. The method of claim 2, wherein not reacting all of said matrix carbon is accomplished by maintaining a temperature of infiltration below about 1600C.

20. The method of claim 2, wherein said not reacting all of said matrix carbon is accomplished by applying said matrix carbon in a thickness greater than about 2 microns.

21. The method of claim 2, wherein said not reacting all of said matrix carbon is accomplished by providing said carbon from a precursor source having a high char yield.

22. The composite body of claim 5, wherein said fibers have an isotropic or quasi-isotropic arrangement.

23. The composite body of claim 5, wherein said fibers are not arranged quasi-isotropically.

24. The composite body of claim 5, wherein said carbon fibers possess a negative CTE in the axial direction.

25. The composite body of claim 5, wherein said carbon fibers do not possess a negative CTE.

26. The composite body of claim 5, wherein said carbon fibers possess an elastic modulus of at least about 200 GPa in the axial direction.

27. The composite body of claim 5, wherein said reinforcement phase is present as at least one sheet or layer, and said thermal expansion coefficient is quasi-isotropic within the plane of said sheet or layer.

28. The composite body of claim 5, wherein said reinforcement phase is present as at least one sheet or layer comprising said fibers randomly arranged within the plane of said sheet or layer.

29. The composite body of claim 5, wherein said fibers comprise graphite having a negative thermal expansion coefficient in a fiber axis direction.

30. The composite body of claim 28, wherein said reinforcement phase comprises a plurality of said layers arranged substantially parallel to one another, each of said layers comprising a plurality of substantially parallel carbon fibers, wherein an absolute value of angle as measured between the longitudinal axes of said carbon fibers in one layer and those in an adjacent layer is selected from the group consisting of 0 degrees, 45 degrees, 60 degrees and 90 degrees.

31. The method of claim 1, further comprising green machining said preform.

32. The composite body of claim 4, wherein said carbon fibers are arranged with respect to one another so as to achieve at least a quasi-isotropic CTE in the formed composite body.

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